Studies on the Prophylactic Care for Postoperative Complications Following Resective Surgery for Carcinoma of the Esophagus Part II. Reconstruction of the Esophagus with Pedunculated Colonic Segment and Postoperative Reflux Colitis

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Part II Reconstruction of the Esophagus with Pedunculated Colonic Segment and Postoperative Reflux Colitis

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Introduction

For the purpose of esophageal reconstruction after resection of esophageal cancer, the gastric and colonic segments are mainly used. Each method has its advantage and disadvantage as to the operative safety and postoperative function of the transplanted digestive tract. One of the reasons for the superiority of the colon as the substitute esophagus, is the abundant mucus secretion by the colon mucosa giving high resistance to acid-pepsin digestion[9)24)28)44)45)]. However, many clinical cases have been reported in which peptic ulcer or its perforation occurred at the site oral to the cologastric anastomotic stoma after reconstruction of the esophagus with colon segment[14)22)26)27)]. On the other hand, the resistance of purified mucosal protein of the colon to acid-peptic digestion was reported to be very low next to the esophagus[41)]. Consequently, many problems remain unsolved as to the esophageal reconstruction with colon segment, especially on the development of postoperative reflux colitis and function of the colon segment.

The present investigations were undertaken to clarify the relationship between the occurrence of postoperative reflux colitis in the colon segment and the site of anastomosis to the stomach, direction of peristalsis of the colon segment and influence of additional vagotomy. The effect of vagotomy on the ability of mucous secretion by colon mucosa was also studied by determination of hexosamine, a mucopolysaccharide.

Materials and methods

Experiment I : Relationship between the site of anastomosis of transplants to the stomach and the incidence of postoperative reflux inflammation in the implanted colon segment.

Thirty healthy adult male and female mongrel dogs weighing 8-17 kg were used. Animals were fasted for 24 hours preoperatively. Anesthesia was given by intramuscular injection of

50mg per kg in body weight of Ketamine-hydrochloride, followed by one half dose, when necessary. During operation, 50ml per kg in body weight of lactated Ringer's & 5% Sorbitol solutions were given by intravenous drip infusion.

Experimental animals were divided into 3 groups according to the site of transplantation and anastomosis in the stomach, that is, anastomoses to the corpus, antrum and pyloric ring, respectively (Fig. 1). Under aseptic surgical procedure, a colon segment of 5 cm in length

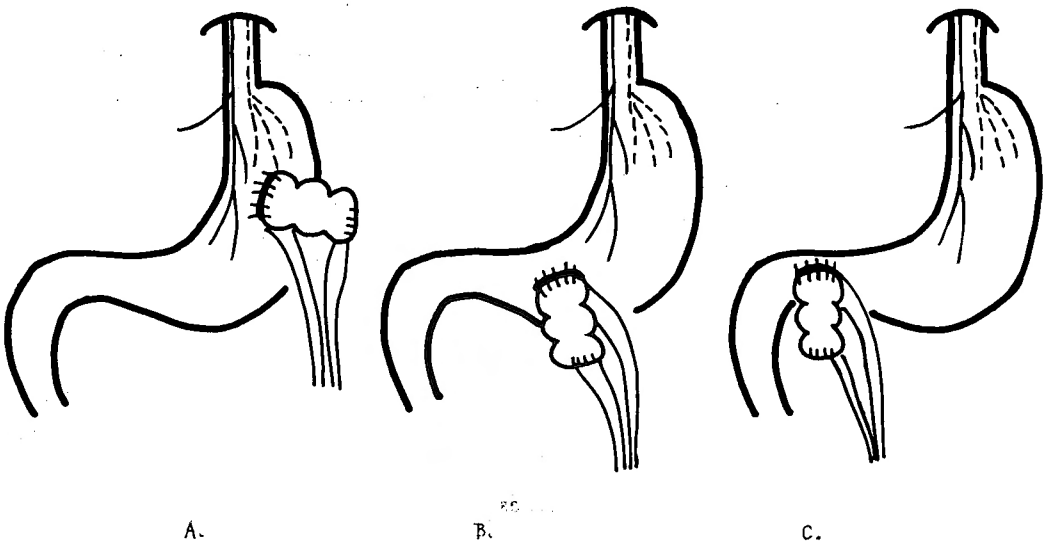

Fig. 1. The colon segments were anastomosed in end-to-side fashion to the corpus (A), the antrum (B) or the pyloric ring (C) of the stomach, preserving the gastric branches of the vagi (Non-vagotomized group).

supplied by the middle colic vessels was prepared from the right half of the colon. The continuity of the colon was restored by end-to-end colocolostomy. The colon segment was transplanted to the stomach in the direction parallel with the long axis of the stomach on its anterior wall. Particular care was taken to avoid twisting and excessive tension of the vascular pedicle. Anastomosis between colon segment and stomach was performed in end-to-end fashion in two layers with a continuous suture using No. 4 silk, and interrupted Lembert sutures using No.3 silk. The diameter of the anastomotic stoma was adjusted to about 2 cm. In the vagotomized group, after truncal vagotomy and pyloroplasty (pyloromyotomy) were performed, the colon segment was implanted in the corpus or antrum by the same procedure used in the non-vagotomized group (Fig. 2).

In order to prevent postoperative infection, 250mg of Tetracycline was administered into the abdominal cavity, followed by an intramuscular injection of 1 g. of Ampicillin sodium. Animals were fasted again for 24 hours postoperatively. Fluid diet was administered from the 2nd postoperative day, followed gradually by solid ration (Oriental Ration for Dogs).

In each experimental dog, 2 mg per kg in body weight of 1% oily histamine[40] was intra-

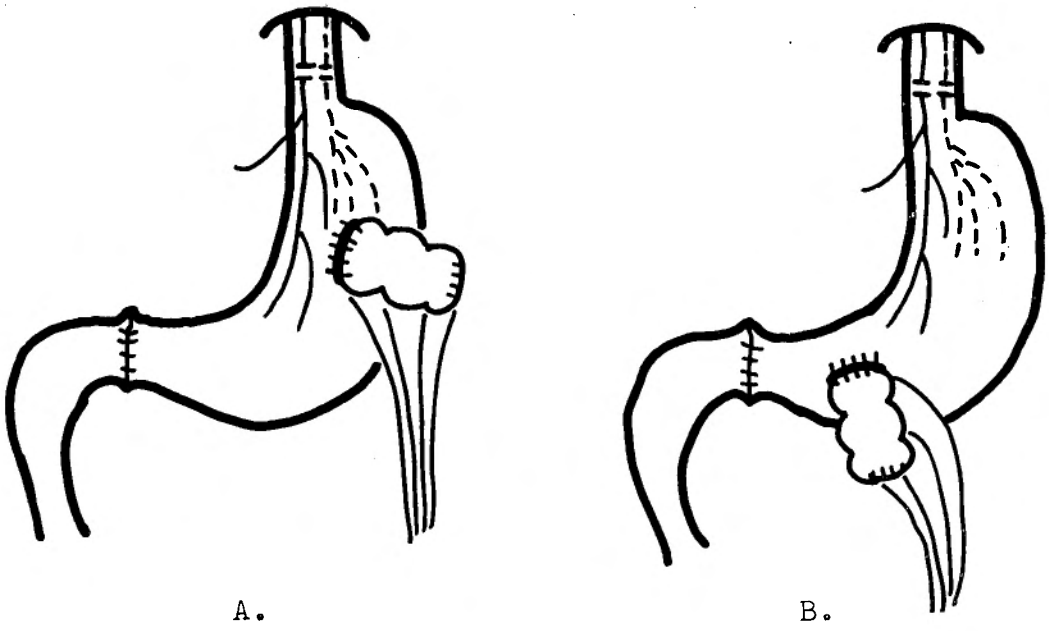

Fig. 2 The colon segments were anastomosed in end-to-side fashion to the corpus (A) or the antrum (B) of the stomach, accompanying with subdiaphragmatic total vagotomy and pyloroplasty (Vagotomized group).

muscularly injected on the 21st and 25th postoperative days. Following the histamine stimulation, animals were fasted for 24 hours. On the 30th postoperative day, the animals were sacrificed by intravenous injection of Pentobarbital sodium, and the degree of inflammation in the implanted colon segment was macroscopically evaluated.

Experiment II: Effect of vagotomy on the hexosamine contents of colonic mucosal tissue.

1) Purification of dry tissue material of colonic mucosa[11]

Fresh colon tissues of 5 adult mongrel dogs weighing 7-15kg were used. After 24 hours of fasting, the animals were sacrificed by intravenous injection of Pentobarbital sodium, and then colon segments of 10cm in length were removed immediately from the right half of the colon and the left half of the colon. After mincing into small pieces and washing out, the fresh colon materials were placed into acetone and left at 5°C for 24 hours. Thereafter, serosal and muscular layers were removed and only the mucosal layer was homogenized. The homogenized materials were again placed into 5°C acetone for 24 hours. Supernatant was discarded and the sediment was centrifuged (2500 r.p.m. for 15 minutes) twice with acetone and further with ether for defatting and dehydration. The purified mucosal tissue was, moroover, completely dried in a desiccater under vacuum reduced pressure for 48 hours.

In 15 adult mongrel dogs, 11.2kg in body weight on the average, truncal total vagotomy and pyloroplasty were carried out under aseptic condition. Colon samples of the vagotomized dogs were obtained after two, three and four weeks from 5 animals, the same as in non-vagotomized controls, to purify colonic mucosal dry materials (Table 1).

Table 1 Technical procedure of the purification of dry tissue material and determination of hexosamine content in the colonic mucosa.

Fresh colonic material.
↓
Treatment with acetone (5 °C, 24 hours).
↓
Homogenate, only mucosal layer.
↓
Centrifugation (2500 r.p.m. 15 minutes).
↓
Desiccation (vacuum desiccater, 48 hours).
↓
Purified dry mucosal tissue.
↓
Hydrolyzation with 3 N-HCl (100°C, 5 hours).
↓
Filtration (11-G-3 glass filters).
↓
Hexosamine determination.

One ml. of each filtrate.
- —2 N-HCl, 2 ml.

Neutralization.
- —1 % phenolphthalein-alcohol, 1 drop.
- —4 N-NaOH, drop by drop until turn red.
- —0.5 N-HCl, until color just disappears.
- —2 % Acetylacetone reagent, 1 ml.

Heating (boiling water bath, 89-92°C, 45 minutes).
- After cooling at room temperature.
- —adding ethylalcohol, 2.5 ml.

Mixture.
- —Ehrlich's reagent, 1 ml.

Mixture.
- Total volume of sample makes up to 10ml exactly with ethylalcohol.

Reading optical density at 530mμ.
(90 minutes after addition of Ehrlich's reagent)

2) Determination of hexosamine contents of the mucosal tissues.

Hexosamine determination was performed according to the method of Boas[5], simplified modification of Elson-Morgan reaction. To 100mg of dry material of colonic mucosa, 2 ml of 3 N-HCl was added and hydrolyzed at 100°C for 5 hours in a sealed tube, followed by the addition of distilled water to bring it up to 10ml. This mucosal tissue hydrolysate was then filtered through 11-G-3 glass filters. One ml of filtrate was placed in a graduated test tube and 2 ml of 2 N-HCl was added. After adding one drop of one per cent phenolphthalein in alcohol as the indicator, 4 N-NaOH was added just until the samples turned red.

0.5N-HCl was then added drop by drop just until the color of samples disappeared. One ml of acetylacetone reagent (2 per cent solution (volume per volume) of acetylacetone in 1 N sodium carbonate) was added to each sample, and then the mixture was heated in a water bath at 89-92°C for 5 minutes. After cooling at room temperature, 2.5ml of ethylalcohol was added and mixed, followed by the addition of one ml Ehrlich's reagent (2.67 per cent solution (weight per volume) of p-dimethylaminobenzaldehyde in 1:1 mixture of ethylalcohol and concentrated hydrochloric acid) and mixing. The final volume of the sample was made up exactly of 10 ml with ethylalcohol. Ninety minutes after the addition of Ehrlich's reagent, the optical density was read at 530 mμ on a spectrophotometer (HITACHI, Type 139). Since Elson-Morgan reaction is subjected to fluctuation by the color development procedure, standard curve was constructed for each determination to calculate the hexosamine contents of the samples.

Results

Experiment I: Occurrence of postoperative reflux colitis in the implanted colon segment.

Among 30 animals used, 4 died of postoperative peritonitis and the remaining 26 animals were evaluated. The results are summarized in the Table 2. The grade of inflammation in the transplanted colon segment was expressed as follows.

Grade I: Redness and edema alone.

Table 2 Incidence of postoperative reflux inflammations of the implanted colonic segments.

	Site of anastomosis in the stomach	Gross autopsy findings: Intact	Grade I	Grade II	Grade III	Total of cases with ulcerative lesions (%)	Total of cases with inflammatory findings (%)
Non-vagotomized group (17)	Corpus (5)	3	1	1	0	1 (20)	2 (40)
	Antrum (8)	0	2	3	3	6 (75)	8 (100)
	pyloric ring (4)	0	1	1	2	3 (75)	4 (100)
Vagotomized group (9)	Corpus (5)	3	0	0	2	2 (40)	2 (40)
	Antrum (4)	2	0	1	1	2 (50)	2 (50)
Direction of peristalsis of implanted colonic segments							
Isoperistaltic (12)		5	3	3	1	4 (33.3)	7 (58.3)
Antiperistaltic (14)		3	1	3	7	10(71.4)	11(78.5)

( ); Number of animals

Fig. 3 Antiperistaltic colon segment anasotomsed to the antrum in non-vagotomized dog. A large, 2.5 by 1.2cm, ulcer is observed in the colon segment adjacent to the anastomotic stoma. Close-up view shows on the left. Arrows indicate the suture line.

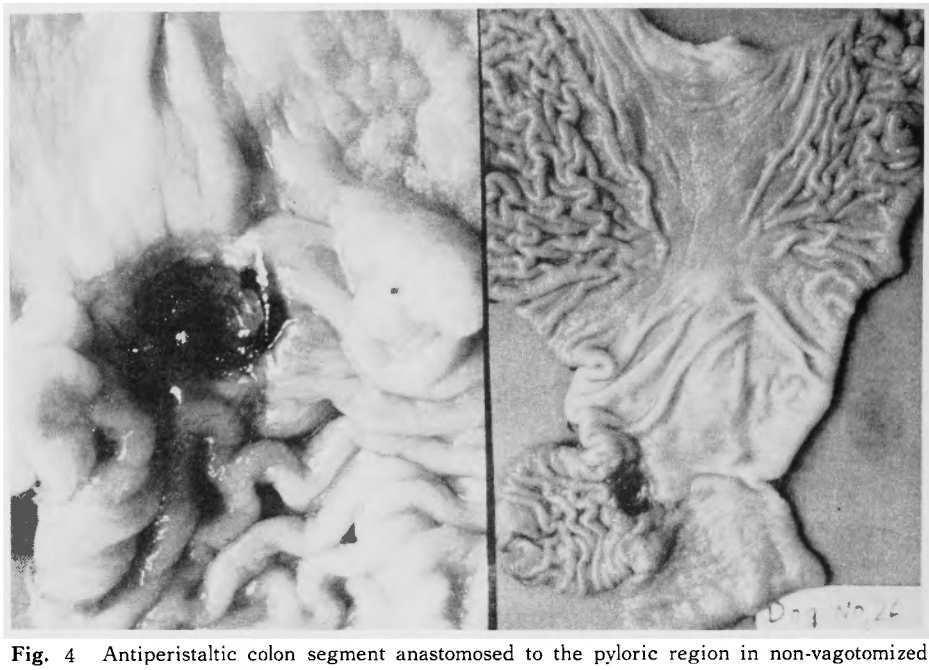

Fig. 4 Antiperistaltic colon segment anastomosed to the pyloric region in non-vagotomized dog. A deep perforated ulcer with hemorrhage is observed. Duodenal loop remains intact.

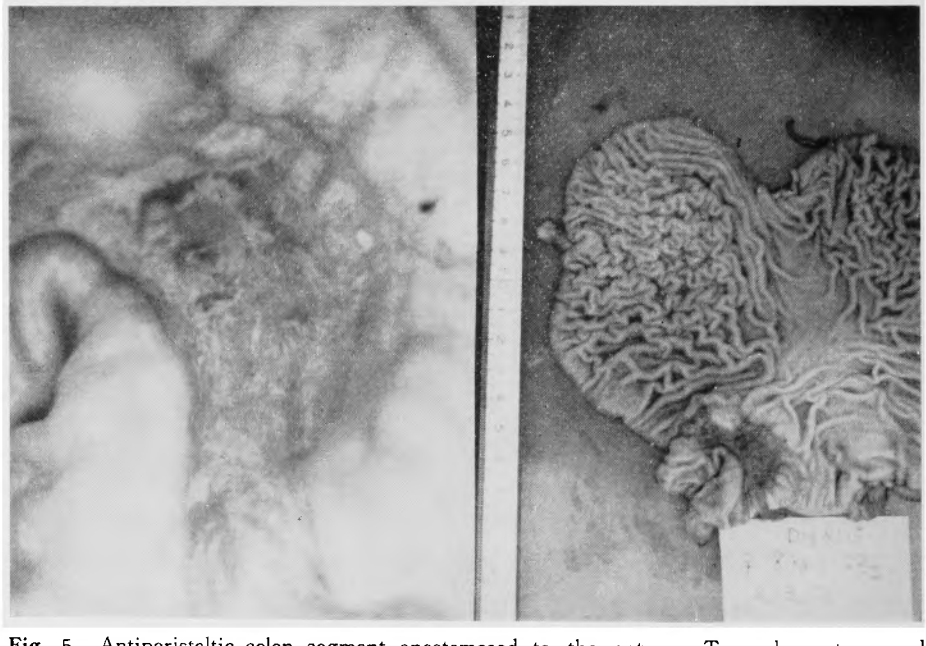

Fig. 5 Antiperistaltic colon segment anastomosed to the antrum, Truncal vagotomy and pyloroplasty were performed. A large deep ulcer, 3.0 by 1.7cm, is observed in the colon segment.

Table 3 Hexosamine contents in 10mg of colonic mucosal dry tissues (μg)

		Right colon	Left colon
Before vagotomy		130	114
		85	100
		114	118
		104	109
		118	83
	$\bar{X}$	110.2	104.8
	SD	16.9	14.0
Two weeks after vagotomy		100	95
		88	83
		76	104
		95	93
		97	81
	$\bar{X}$	91.2	91.2
	SD	9.9	9.4
Three weeks after vagotomy		81	83
		62	76
		48	62
		76	95
		55	97
	$\bar{X}$	64.4	82.6
	SD	14.0	14.4
Four weeks after vagotomy		98	114
		114	100
		109	133
		126	116
		121	109
	$\bar{X}$	112.6	114.4
	SD	12.8	12.1

Grade II: Erosion.

Grade III: Ulceration.

In non-vagotomized dogs, Grade I and II inflammations were noted only in 2 out of 5 animals with anastomosis to the gastric corpus. On the contrary, inflammatory lesions were noted in all of 8 animals with anastomosis to the antrum (including 3 dogs with anastomosis on the posterior wall), and all of 4 animals with anastomosis to pyloric ring. These inflammatory lesions were mostly ulcerative changes of Grades II and III. Postoperative reflux colitis tended to occur frequently in the group with anastomosis to the pyloric antrum in non-vagotomized dogs ($p=0.03$). In vagotomized dogs, on the other hand, ulceration was noted in 2 out of 5 animals with anastomosis to the corpus. In 2 out of 4 cases in the group of anastomosis to the antrum, inflammatory changes of Grades II and III were noted. The addition of vagotomy and pyloroplasty caused no remarkable differences in the incidence of reflux colitis according to the site of anastomosis to the stomach. Occurrence of postoperative reflux colitis was 44.5 and 76.9 per cent in vagotomized and non-vagotomized animals, respectively, the former being lower. Such tendency was especially more pronounced in the group with anastomosis to the antrum. In regard to the difference according to the direction of peristalsis of the transplanted colon, reflux colitis occurred in 11 out of 14 cases (78.5%) with transplantation in the antiperistaltic direction, including 7 cases of peptic ulcer, while it appeared in 7 out of 12 cases (58.3%) with isoperistaltic transplantation, with ulcer formation in only one case. As to the direction of peristalsis, therefore, a tendency of frequent occurrence of reflux colitis was noted in cases with antiperistaltic transplantation ($P<0.10$) (Fig. 3, 4, 5).

Experiment II: Effect of vagotomy on hexosamine contents of colonic mucosa.

Hexosamine content was expressed as the amount of glucosamine-HCl per 10 mg of dry mucosal tissues. The contents values of each group are summarized in the Table 3.

In the control group, right colon gave the mean value of $110.2\pm7.5\mu$g, and left colon, $104.8\pm6.2\mu$g. In the vagotomized group, right colon gave the value of 91.2 ± 4.1 and left

colon 91.2±4.0, two weeks after vagotomy. In the 3rd postoperative week, right colon gave 64.4±6.2 and left colon 82.6±6.4, representing a decrease of hexosamine content by 41.6 per cent in the right colon and 27.8 per cent in the left colon.

Hexosamine contents of the right colonic mucosa especially showed a remarkable decrease from the 2nd to 3rd week after vagotomy. This was statistically significant ($p<0.01$). In the 4th postoperative week, however, hexosamine contents returned to the preoperative level, 112.6±5.7 μg in the right colon and 114.4±5.4 μg in the left colon. Hexosamine contents of the colonic mucosa were significantly different statistically between the right colon and the left colon only in the 3rd postoperative week ($p<0.05$) (Table 4 and Fig. 6).

Discussion

Dragstedt and Vaughn[9] reported that a patch of colon with vascular pedicle could be implant-

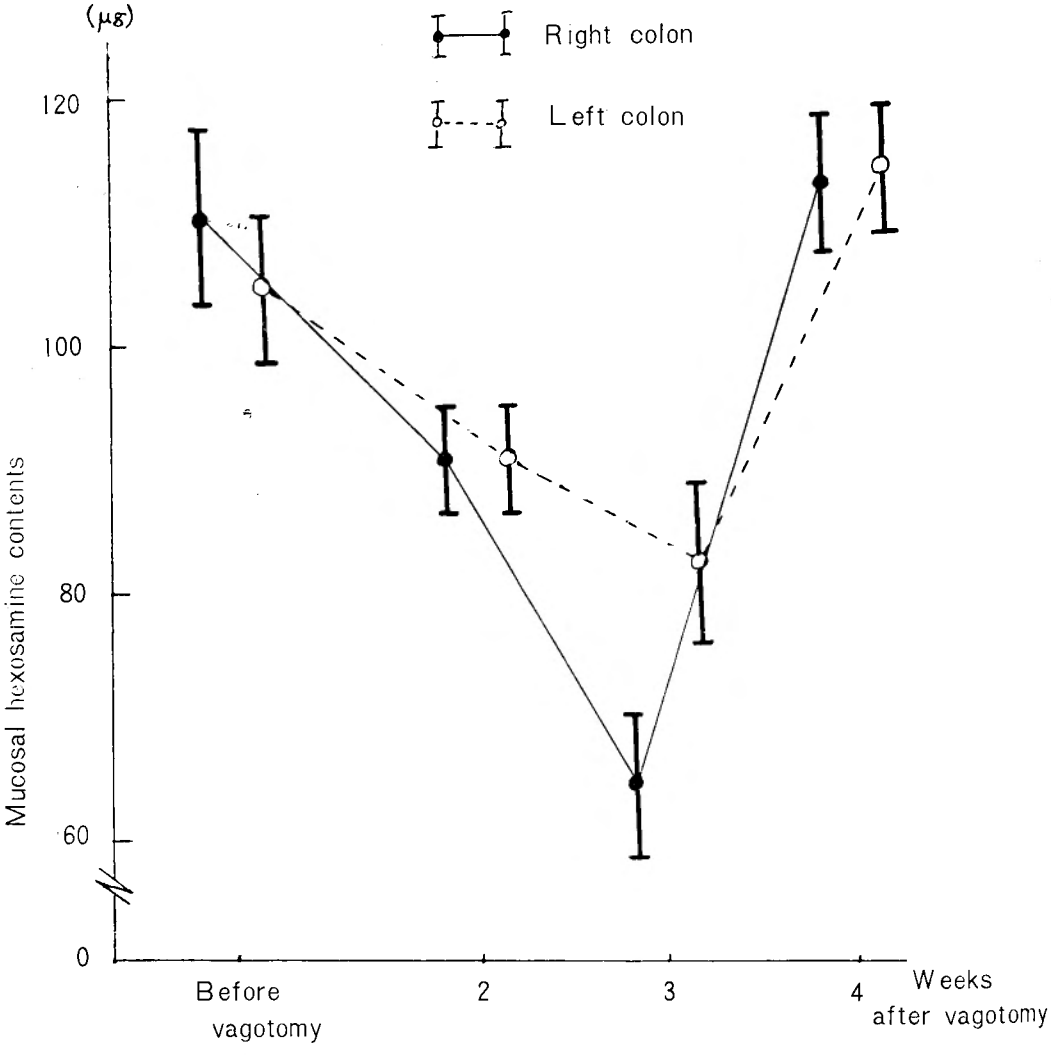

Fig. 6 Effect of vagotomy on the hexosamine contents of the colonic mucosa.

Table 4 Changes of hexosamine content values (μg) in the colonic mucosal tissue before and after vagotomy.

(Mean± SE)

	Before vagotomy	After vagotomy		
		Two weeks	Three weeks	Four weeks
Right colon	110.2±7.5	91.2±4.1 *	64.4±6.2 **	112.6±5.7
Left colon	104.8±6.2	91.2±4.0	82.6±6.4 **	114.4±5.4

* $p<0.05$ ** $p<0.01$ (n=5)

ed in the stomach without peptic digestion. These experiments have been explained by some authors[23][24][28] to suggest increased resistance of colonic mucosa to digestion by gastric secretions. However, Sirak, Clatworthy and Elliot[38] have shown that, in dogs, colonic segments are more sensitive to peptic digestion than jejunal segments when implanted to the inlet of the stomach and stimulated with histamine. In fact, Nardi & Glotzer[27], Menguy[26] and Holland[14] reported clinical cases of severe peptic ulceration of the colon following colonic replacement of the esophagus. It would appear that there is little evidence to support the view that peptic ulceration in colonic replacements of the esophagus is rare because of the resistance of colonic mucosa to gastric reflux, as it was pointed out by Holland. However, there seems to be little doubt that the colon is not nearly so susceptible to digestion as the esophagus, which shows remarkably low resistance to acid-peptic exposure[20][27].

According to Battersby, Nardi and Schermann[18], ulcerative reflux colitis as a postoperative complication of the colonic replacement of the esophagus, occurs more frequently in antiperistaltic transplantation, with an incidence of 1.5 per cent.

As a method of prevention of such reflux colitis, Póka and Illés[33] divised a mode of procedure for preparing a valve at the anastomotic site of the colon to the stomach.

The author inferred that a difference in the incidence of postoperative reflux colitis depends upon the portion of anastomosis in the stomach. Regarding the method for preventing reflux colitis, the suitable region of the stomach for the colon transplantation was, therefore, studied experimentally. The right colon segment with blood supply by the middle colic vessels, in dogs, was transplanted to the stomach under various conditions to investigate the degree of inflammation in the implanted colonic segments.

In non-vagotomized dogs, the reflux colitis occurred more frequently in the group with anastomosis to the pyloric ring or the antrum than that to the corpus, quite unexpectedly.

Reflux colitis evidently is caused by the reflux of gastric juice with high acidity. As it is shown in the present experiment, a marked difference was noted according to the site of anastomosis in the stomach. Since it is hardly conceivable that the resistance of the transplanted colonic mucosa to acid-peptic digestion weakens depending upon the site of transplantation to the stomach, it appears reasonable to ascribe it to the difference of peristaltic movement of the stomach at each portion and its ability to produce acid-peptic juice.

It is stated that the antiperistaltic movement of the stomach, according to the results of electromyographic studies[6)36)]on the regional difference in gastric motility, occurs mainly from the pyloric ring, while the remaining from the antrum, and the amplitude of the peristaltic discharge is the highest in the antrum, being more than 3 times as high as that in the corpus.

According to electromyographic observation on the canine stomach subjected to transection and end-to-end anastomosis, on the other hand, hypermotility is noted in the portion of the stomach anal to the site of transection and anastomosis, moves from the corpus to the antrum towards the anal periphery, and antiperistaltic movement also occurs frequently[39)]. Okabayashi [30)]observed that the pressure due to contraction of the pyloric ring after transection and anastomosis of the stomach decreases at the level oral to transection in the corpus, but the pressure showed the highest value following transection in the antrum.

Such regional difference in gastric motility and the contractile pressure of the pyloric ring influenced by the site of transection and anastomosis might suggest, as shown in the present experimental results, that the degree of reflux of gastric juice into the implanted colon could become more pronounced in the group with anastomosis to the antrum than in the group with anastomosis to the corpus in dogs with intact vagus.

It is also stated that the autonomic ability of the gastric wall to generate antiperistalsis, or pacemaker-like elements becomes more effective towards the pyloric part than from the cardial part, and pacemaker control on the normoperistalsis of the oral side inhibiting the occurrence of antiperistalsis at the pyloric part. On the other hand, it is known to become gradually weaker towards the pyloric side[37)]. Consequently, after the anastomosis was made to the gastric wall, especially to the antral wall, disturbance of propulsion of gastric contents occurred because of the autonomic ability for antiperistalsis and irregularity in its pacemaker control. Intragastric pressure thus rises and provides a mechanical dilatatory stimulus to the antral wall, stimulating gastrin release in the so-called antral phase of the gastric secretions. In the group of anastomosis to the antrum with intact vagus, therefore, transplants are much exposed to the acid-peptic digestion.

The incidence of postoperative reflux colitis in vagotomized dogs is 44.5 per cent, lower than in dogs with intact vagus which is 76.9 per cent. Such result is probably due to the block of cephalic phase of gastric secretion following vagotomy, leading to inhibition of secretion of gastric acid-pepsin. After vagotomy, however, gastric dilatation takes place because of a decrease of the gastric tonus, with increased retention of gastric contents.

The dilatatory stimulus to the antrum tends to stimulate gastrin release. From such disturbance of the propulsion of gastric contents after vagotomy, drainage effect by means of pyloroplasty was expected in the present experiment.

Many reports[10)21)29)49)]are available on the vagal innervation of the gastric antrum and mechanism of gastrin secretion. According to Dragstedt et al.[10)], gastrin secretion in response to intrinsic nerve stimulation based on retention of gastric contents is greater than that induced by stimulation of the vagus. In the present experiment, therefore, gastrin secretion

in the antral phase was mostly preserved also in the vagotomized dogs and implanted colon was still under the action of acid and pepsin. In this present studies, however, concentration of gastrin, a humoral factor stimulating gastric acid secretion, in blood was not determined and whether or not a difference exists in blood gastrin level depending upon the site of anastomosis of the colon to the stomach remains unknown.

In all cases with vagotomy, despite the drainage procedure due to pyloroplasty and acid-decreasing effect by truncal vagotomy, complete prevention of postoperative peptic ulceration in the implanted colon segments was not possible to achieve. Moreover, no difference was seen in the incidence of postoperative reflux colitis depending upon the site of anastomosis to the stomach. Peptic ulcer was formed in 40 per cent of the cases even in the group with anastomosis to the corpus.

The cause of peptic ulceration is influenced by plural and muliple factors, as Hollander[15] and Shay[35] have stated. Locally, a breakdown of the balance between aggressive factors, such as acid-pepsin, cathepsin[40], and defensive factors of the mucosa, results in ulcer formation. The defense mechanism of the mucosa against aggressive factors mainly consists of mucus and local mucosal blood flow[12]. The mucus covers the surface of mucosa as mucous barrier, exerting acid neutralizing and pepsin inactivating actions playing a part in mucosal resistance[14]. Mucosal mucus mainly consists of mucopolysaccharides, and it is known to consist, chemically, of hexose, fucose, sialic acid, hexosamine and protein[1]. The changes in hexosamine contents, one of the components, might become the index for the changes of mucosal resistance.

From such viewpoint, changes of the components of mucus of colonic mucosa were studied at various intervals following vagotomy. The mucosal hexosamine content of the colon was found to decrease gradually after truncal vagotomy. Three weeks after vagotomy, a decrease of 27.8 per cent was shown in the left colon and a decrease of 41.6 per cent in the right. The resistance of colon mucosa to acid-pepsin digestion thus appears to decrease temporarily after vagotomy. The great decrease was noted at 3 weeks after vagotomy and the decrease was more pronounced in the right half of the colon where vagal control is dominant, compared with the left half of the colon where parasympathetic innervation from the pelvic nerve is dominant.

As to the mechanism of mucus secretion, many things still remain unknown.

Jacobson[19] and Demling[8] found a correlation between mucosal secretion and mucosal blood flow. Thompson and Vane[42][43] concluded that a direct influence of blood flow on mucosal secretion existed. In regard to the relationship between vagotomy and blood flow in the area of innervation, Ballinger[2] found a decrease of blood flow rate of 42 ± 11.6 per cent after total vagotomy. Ishigami & Hiramatsu[17][18] reported a decrease of blood flow through the superior mesenteric vein of 53.2 per cent and that of inferior mesenteric vein of 14.7 per cent, immediately after subdiaphragmatic total vagotomy. According to Padula[31] and Ballinger[3], decrease of blood flow through the capillary blood vessels in the villi of intestinal mucosa after vagotomy causes atrophy of the mucosal epithelium and such a change was most pronounced 3 weeks after vagotomy. According to the results of a follow-up study[7] on blood flow through the

splanchnic area using^{86} RbCl, decreased blood flow through the colon returns to the preoperative level 4 to 6 weeks after vagotomy.

Agreement among these results by various investigators on the change of blood flow after vagotomy and the experimental results of the present authors on mucus secretion by colonic mucosa is by no means coincidental. A decrease of blood flow through the colonic mucosa in response to vagotomy and a decrease of mucus secretion make it appear that there are two sides to one phenomenon. In the transplanted colon in vagotomized dogs, decrease of mucosal blood flow and mucus secretion lead to the weakening of the defense mechanism. Especially around the 3rd week after vagotomy, susceptibility to ulceration was probably present. After vagotomy, acid and pepsin secretion was somewhat inhibited by the blocking of the cephalic phase, etc. On the other hand, mucosal resistance would probably decrease after vagotomy, as described above.

In vagotomized dogs, consequently, the incidence of postoperative reflux peptic ulcer in the implanted colon segments showed no difference depending upon the site of anastomosis to the stomach. Despite the expectation on the acid-decreasing effect by total vagotomy and drainage effect due to pyloroplasty, peptic ulcer occurred, probably for the reason stated above. Decrease of defensive factors such as mucosal blood flow and mucus secretion in the pedunculated right colonic segments rather than aggressive factors such as acid and pepsin appear to play important roles.

As to the choice between two types of anastomoses in the direction of isoperistalsis or antiperistalsis in the colonic replacement of the esophagus, many reports are so far available, but no definite conclusion has been arrived at yet. Beck[4],May[25]and Hopkins[16]denied the presence of peristaltic movement in the transplanted colon by explaining that the transport of the content of elevated and implanted colon is almost exclusively due to gravity, ruling out the possibility of antiperistalsis. Fairman[12], on the contrary, considered antiperistalsis to be unfavorable. Rappaport[34]and Petrov[32]found postprandial regurgitation after transplantation favoring antiperistalsis. These reports, however, only deal with the food passage and presence of postprandial regurgitation. The authors studied the adequacy of the direction of peristalsis in the transplanted colon, from the viewpoint of postoperative reflux colitis. Postoperative reflux colitis occurred in 78.5 per cent of the cases with antiperistaltic transplantation. The ulcerative lesions tended to occur more frequently in cases with antiperistaltic transplantation. Since these results were obtained without uniform conditions such as the use of vagotomy and difference in the site of transplantation to the stomach, a conclusion should be deferred. In any case, isoperistaltic transplantation appears to be desirable to prevent ulcerative reflux colitis.

Summary and conclusions

In order to observe the mode of occurrence of reflux colitis following esophageal reconstruction with pedunculated colonic segment, experimental studies were carried out in dogs. The right colon segments with blood supply by the middle colic vessels were transplanted and

anastomosed to the stomach under various conditions. After histamine stimulation, the gross finding of the implanted colonic segments were evaluated on the 30th days after operation, in order to clarify the differences due to the site of transplantation to stomach, direction of peristalsis and influence of vagotomy. The effect of vagotomy on the resistance of the colon to peptic digestion was also studied through determination of hexosamine contents of the mucosa by the Boas modified method, and the following results were obtained.

1) Incidence of postoperative reflux colitis was higher in the group with anastomosis to the pyloric antrum than that to the corpus, in non-vagotomized dogs ($P < 0.03$).
2) When total vagotomy and pyloroplasty were added, the incidence of reflux colitis was 44.5 per cent, lower than 76.9 per cent in non-vagotomized dogs ($P < 0.05$). However, no difference was noted as to the site of anastomosis of the colonic segments to the stomach.
3) Comparsion of the incidence according to the direction of peristalsis of the implanted colon revealed 78.5 per cent in cases of the antiperistaltic transplantation and 58.3 per cent in the isoperistaltic. In the former, peptic ulcer tended to occur frequently($P < 0.10$).
4) Hexosamine contents of the colonic mucosa gradually decreased after total vagotomy. Three weeks after vagotomy, content values in the right colon decreased by 41.6 per cent and that in the left colon by 27.8 per cent ($P < 0.01$). Four weeks after vagotomy, however, it returned to preoperative values.

These results would indicate that the colonic segment should be anastomosed to the anterior wall of the corpus in the isoperistaltic direction with additional pyloroplasty, in the esophageal reconstruction by means of the pedunculated colonic segment. This should be especially necessary in a bypass operation with intact vagus rather than esophageal reconstruction after esophagectomy with vagotomy. In a multistaged operation, on the other hand, when the right half of the colon with marked decrease of mucosal resistance due to total vagotomy is used for esophageal reconstruction, it would be desirable to perform its reconstruction four weeks after esophagectomy which is inevitably accompained by vagotomy, to prevent postoperative reflux colitis.

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和文抄録

食道癌術後合併症に関する研究

第2編　有茎結腸管による食道再建術と術後逆流性結腸炎

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食道再建にさいしては，一般に有茎胃管あるいは有茎結腸管が用いられているが，手術の安全性，術後機能などの点において一長一短がある。とくに有茎結腸管による食道再建術については，術後の逆流性結腸炎の発生，移植結腸管の機能などの点でいまだ解決すべき多くの問題を残している。

そこで著者は有茎結腸管による食道再建術後の逆流性結腸炎の発生状況を観察する目的で，イヌを用いて中結腸動静脈で栄養される右結腸分節を各種条件下に胃に移植・吻合し，histamine 刺激を加えて，術後1カ月目の移植結腸管の炎症程度を比較・検討するとともに，結腸粘膜の粘液成分におよぼす迷走神経切断の影響について，粘膜 hexosamine 量をBoas の変法によって経時的に測定して，次のような成績を得た。

1）術後逆流性結腸炎は，迷走神経保存犬においては幽門・前庭部吻合群の方が胃体部吻合群に比べて高率に発生した（$P<0.03$）。

2）また横隔膜下完全迷切および幽門成形が追加された場合，その発生頻度は44.5%であり，非迷切群における発生率76.9%に比べて低率であった。しかし胃への移植・吻合部位による発生頻度の差異は認められなかった。

3）移植結腸管の蠕動方向による発生頻度の差異は，逆蠕動性移植例では78.5%，順蠕動性移植例では58.3%に発生し，とくに前者においては消化性潰瘍が多発する傾向を認めた（$p<0.10$）。

4）結腸粘膜 hexosamine 量は横隔膜下完全迷切によって漸減し，迷切後3週目には切離前に比べて左結腸では27.8%，右結腸では41.6%も減少した（$p<0.01$）。しかし迷切後4週目には術前値のレベルにもどった。

以上の成績から，食道再建に使用される有茎結腸管の肛門側端を胃に吻合するさいには，術後逆流性結腸炎の立場からすると，順蠕動性に胃体部前壁に移植・吻合し，さらに幽門成形を加えることが望ましく，しかもこのことは迷走神経切断を伴う食道切除後の再建例においてよりも，迷走神経が保存される by-pass 手術例や下咽頭頸部食道癌切除後の再建例においてとくに留意する必要があるといえる。また一方，食道切除を先行する分割手術においては，両側迷切によって結腸粘膜の粘液分泌能が著明に低下する結腸右半部を使用する食道再建術は，食道切除後4週以後に行なうことが術後逆流性潰瘍性結腸炎の発生を防止する点から好ましいと考えられる。